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GEOLOGY.—*Tentative correlation of American glacial chronology with the marine time scale.*[1] C. WYTHE COOKE, U. S. Geological Survey.

When the great ice sheets crept down from the north during the Pleistocene epoch and covered Canada and parts of the northern States of the Union, they brought with them boulders and other spoil torn from the land across which they had pushed. At the southern end of each sheet, where the ice melted as rapidly as that behind advanced, great piles of débris accumulated in the form of terminal moraines or was swept onward by gushing rivers. Whenever the ice melted faster than it advanced, the ice front retreated northward and the ground beneath it was once more exposed to the weather. Soil formed, vegetation grew, and animals that had been driven away by the advance of the ice returned to graze, browse, or hunt.

After many years of intensive study of the glacial deposits, geologists have unravelled the tangled thread of Pleistocene history and have woven from it a brilliant tapestry depicting the interesting events of the Ice Age. They recognize a whole series of invasions of the ice each of which is separated from the preceding and succeeding invasions by long intervals of more or less complete deglaciation. Although there is not complete agreement among glacial geologists as to the details of what happened during the Pleistocene, most of them think that there were five principal periods of glaciation and that the last, the Wisconsin glacial stage, was marked by four separate advances of the ice. Altogether, therefore, there were at least eight glacial stages or substages and seven interglacial stages or substages.

While these battles between the forces of summer and winter were cutting their scars on the land, what was happening to the sea? Every ton of ice that was piled upon the land during the glacial stages came ultimately from the sea and was returned to it when it melted. Thus the level of the sea fell or rose as the continental ice caps waxed and waned. The comparatively short glacial stages were times of low water in the sea. During the much longer interglacial stages the

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oceans overflowed their basins and flooded the low margins of the continents. The marks made by the sea on the continents during the glacial stages are now submerged, but the abandoned strand lines of the interglacial stages, flanking marine terraces, now stand above sea level. Eight such high strand lines have been detected along the Atlantic coast of the United States and in many other parts of the world.

The problem of correlating the glacial deposits with the marine Pleistocene terraces and strand lines is difficult of direct attack because the glacial deposits are best developed inland, far from the coastal terraces. Field studies in New Jersey and on Long Island, where

TABLE 1.—TENTATIVE AGE OF PLEISTOCENE TERRACES

Approximate altitude of strand line		Name of terrace	Glacial and interglacial stages
Feet	Meters		
270	82	Brandywine	Pre-Nebraskan warm stage Nebraskan glacial stage
215	66	Coharie	Aftonian interglacial stage Kansan glacial stage
170	52	Sunderland	Yarmouth interglacial stage Illinoian glacial stage
100	30	Wicomico	Sangamon interglacial stage Iowan glacial stage
70	21	Penholoway	Peorian interglacial stage 1st Wisconsin glacial substage
42	13	Talbot	1st Wisconsin interglacial substage 2nd Wisconsin glacial substage
25	8	Pamlico	2nd Wisconsin interglacial substage 3rd Wisconsin glacial substage
12	4	Princess Anne	3rd Wisconsin interglacial substage 4th Wisconsin glacial substage

late Wisconsin moraines cut across several terraces, may yield definite evidence as to the relative ages of the later members of the two series, but the earlier glacial deposits are not completely represented there.

An indirect method of arriving at tentative correlations of the two types of deposits is to compare the sequence of glacial stages with the sequence of strand lines and terraces. The latest Pleistocene strand line should correspond to the latest interglacial stage and each successively older strand should fit into its corresponding place in the glacial chronology. An attempt to do this was made in 1930[2] but the

[2] C. Wythe Cooke. *Pleistocene seashores.* This JOURNAL **20**: 389–395. 1930; *Correlation of coastal terraces.* Jour. Geology **38**: 577–589. 1930.